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GRACE

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Construction Products Division

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May 31, 1977

15151624

BINDER DEVELOPMENT PROGRAM P-204
WEEDSPORT SPRAYING TESTS ON LIBBY #1
MAY 9, 1977

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Objectives:

- . Reduce airborne fiber levels below the goal established for consumer products with the addition of water soluble additives.
- . Compare the airborne fiber reducing capability of three additives.
- . Evaluate new binder spray system design and installation.

Background:

Tests conducted at Weedsport the month of March (see report dated May 24, 1977) established the feasibility of using water soluble binders to lower airborne fiber levels. However, the material having the lowest fiber level, sodium silicate, was not a suitable additive. C.P.D. R&D conducted some laboratory tests which showed that CMC and Starch were possible alternatives. Accordingly, a test series was planned using these additives at various concentrations and addition rates. The goal for airborne fiber levels as established by the fiber committee was 0.2 f/ml T.W.A. and 1.0 f/ml on 15 minute exposure.

Test Method:

Tests were conducted as outlined in Table 1, Page A-1. All additives were sprayed directly into the material at the bagging spout using the new binder mixing and spraying system. Flow rates versus nozzle pressures were established for bag filling times at both screened and unscreened bagging spouts (see appendix Pages A-6-8). All bags were weighed and six consecutive bags were selected from each test for volume checks. Drop tests and simulated attic fill tests were conducted on each test material. Materials of Test Series No. 12 were screened over a 14 mesh screen. Standard quality control checks were taken of all test material.

Volume checks and drop tests will be taken at 30 and 60 day intervals to determine effect of time on shrinkage and fiber levels.

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Weedspout Spraying Tests on Libl #1 - May 9, 1977
Page 2

Conclusions:

1. Drop test airborne fibers levels were reduced by 90% on the screened material (Test 12D) with the addition of 0.98 qts./cf. On the unscreened material the levels were reduced by 81% (Test 11B) with the addition of 0.30 qts./cf (Table 4, Page A-4).
2. Simulated attic fill airborne fiber levels were reduced by 43% on the screened material (Test 12) with the addition of 0.98 qts./cf. On the unscreened material they were reduced by 34% (Test 11B) with the addition of 0.30 qts./cf (Table 5, Page A-5).
3. None of the airborne fiber levels from either drop tests or from simulated attic fill jobs meet the goal of 0.2 f/ml T.W.A. or 1.0 maximum on 15 min. exposure. The best result was Test 12D which had a drop test maximum in 10 mins. of 2.14 f/ml and a T.W.A. of 1.143 f/ml. This same material had a simulated attic fill test of 1.26 max. in 17 min. exposure and 0.88 f/ml T.W.A. with a projected T.W.A. of 0.22 f/ml based on pouring 2 hr./8 hr. (Table 5, Page A-5).
4. Drop test fiber levels are much higher than simulated attic fill tests in all cases.
5. Results in Table 5 show that, on the material applied in the simulated attic fill tests, screening appeared to have as much effect on reducing airborne fiber levels as did binder addition.
6. Drop tests should still be used to evaluate attic fill since theoretically they more nearly simulate a worse method of application than the simulated attic fill tests. If attic fill tests are used a "worst" case method should be employed.
7. Shrinkage losses are around 12 to 13% at the highest addition rate and 6 to 7% at the lowest addition rate (Table 2, Page A-2).
8. No conclusion can be made on the results of the comparison between the three additives used.
9. The binder spray system has good versatility and can handle a wide range of flow rates.

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Weedspout Spraying Tests on Libb #1 - May 9, 1977
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Recommendations:

1. Tests should be conducted to further evaluate the effect of screening on fiber reduction. (Tests were run the week of 5/23/77 on screening versus no screening.)
2. A statistically sufficient number of drop tests should be run on the same material to evaluate the reproducibility of the drop test.
3. Drop tests or "worst" case attic tests should be the method by which attic fill is evaluated.
4. If binder addition must be used for the short term, intensive efforts at air separation should start immediately. (Note: some further air separation tests have been done; see report and recommendations dated 4/21/77 - Airborne Fiber Removal by Air Separation - P-207. Tests recommended in this report were done the week of 5/16/77 at Kearney and drop tests on the material will be done the week of 6/6/77.)

Results:

1. None of the fiber counts, either from drop tests or from simulated attic jobs, meet the goal of 0.2 f/ml T.W.A. and 1.0 maximum based on 15 min. exposure. Test 12D had the lowest results with a maximum fiber count of 1.26 f/ml based on 10 min. exposure and a T.W.A. of 0.22 f/ml based on 2 hrs. exposure in 8 hrs. (Table 5, Page A-5.)
2. Drop tests on the untreated control material 12A (screened) and 9A (unscreened) indicate a lower fiber count for screened material than for unscreened. (11.045 f/ml vs 17.245 f/ml.) This lower fiber count is also apparent when the same 12A and 9A materials are used in the simulated attic test (1.66 f/ml vs 4.99 f/ml). However, while the drop test showed decreased fiber levels as the amount of binder is increased, the simulated attic fill tests fiber levels show no similar decrease in fiber levels and, in fact, the results indicate screening the material had as much beneficial effect as binder addition.

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Weedspout Spraying Tests on Libt #1 - May 9, 1977
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Results, Continued:

3. In the 12 series tests, the material was screened over a 14 mesh screen. The quantity of "unders" was very small and consisted of fine rock, tremolite bundles, and dust. Tests showed this material to be 40 - 44% heavy particles.
4. In all tests, the fiber levels obtained from the drop tests are much higher than those obtained from the simulated attic tests. It is apparent that method of application will have a bearing on fiber release. If the product is removed from the bag with very little free dropping, as is the case in many attics where a man works on his knees, the fiber levels will be much lower than if the material is poured from a height such as a man standing would do. However, to be effective, the binder will need to suppress airborne fibers in the worst possible case.
5. Table 2, Page A-2 shows the shrinkage in the bag. Without any additive, the loss due to breakdown in handling is approximately 2%. With binder addition at 0.30 qts./cf, the loss increases to 6-7%. However, both control tests 9A and 12A show the initial volume to be 4.0 and 3.98 cu. ft. Therefore, it is likely that the vermiculite starts shrinking as soon as it is bagged, so that there is a loss between the time it is bagged and the initial volume check 15 to 30 mins. later.
6. In Table 3, Page A-3 are shown the results of the quality control tests. The vac numbers are quite low indicating this material would shrink considerably. The furnace was operating at 1860°F and producing some clinkers so that the temperature could not be raised to increase the vac number.
7. The binder spray system worked very well and by changing nozzle caps (Page A-8) an addition rate of 0.25 qts./cu. ft. to 1.4 qts./cu. ft. can be obtained. For rates lower or higher than this, a different nozzle size is required. Some small changes to piping and some control recommendations have been made for better utilization of the equipment.

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Weedspout Spraying Tests on Libl #1 - May 9, 1977

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8. Comparison of the three additives used, 2% starch + 10% potassium silicate + 0.01% war (Test 9B); 0.5% CMC + 1.0% potassium silicate + 0.01% war (Test 10B); and 0.5% CMC + 0.01% war (Test 11B) show in drop tests that Test 9B and 11B had fiber levels of 3.848 and 3.280 f/ml versus 6.271 f/ml for Test 10B. (Table 4, Page A-4). However, in the simulated attic fill tests, 10B material had a lower fiber level 2.365 f/ml than 9B material 3.035 f/ml. No conclusion can be made on which is best.

Discussion:

1. From the results of these tests, it appears that screening does have a beneficial effect on lowering fiber levels. It is difficult to understand why this should be so. The bag hopper vent was closed and the only venting was at the bagging spout. If the tumbling action of the vermiculite over the screen loosens the fibers, air would be required to remove them because of their weight. One would think they would not pass through the screen. More testing will be required to verify this result.
2. Since method of application will have a great effect on airborne fiber levels, and since as a consumer product, we will have no control over the method of application in attic fill, the measurement of airborne fiber reduction should be on the worst possible case. Accordingly, the drop test will still need to be the test used to evaluate attic fill since it more nearly simulates the worst case where a man pours the bag from a standing position.
3. Shrinkage losses increase from 8 to 11% at 0.30 qts./cu. ft. to 12 to 13% at 0.98 qts./cu. ft. the material appears to shrink quite fast initially and gradually slows down. Given enough moisture and time it may even approach the shrinkage measurement of the vac test (100-vac = % shrinkage). Measurements will be taken at 30 and 60 days on this material to further define the effect of time on shrinkage.

M. M. Williams

M. M. Williams

5/31/77

MMW:mt

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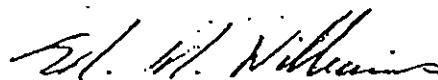
BINDER DEVELOPMENT PROGRAM P-204

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ADDENDUM TO REPORT DATED MAY 31, 1977
WEEDSPORT SPRAYING TESTS ON LIBBY #1

Six consecutive bags were selected from each test and checked for shrinkage after 3 days (Table 3, Page A-3). The same bags were re-checked for both weight and volume after 24 days. The results, tabulated below, demonstrate that the loss of volume caused by shrinkage does not stop after a few days. A further re-check will be made after 60 days. Also tabulated below are the average weight losses caused by the material drying in storage or in the case of unsprayed material, the weight gain due to absorption of atmospheric moisture.

Test No.	Ore	Initial Avg. Vol.	Avg. Loss After 3 Days	Avg. Loss After 24 Days	Weight Loss or Gain After 24 Days	Spray Qts./CF Rate
9A	#1L	3.98	1.4%	4.1%	+0.8%	-
9B	"	3.83	7.0%	15.7%	-0.8%	Starch + Pot.Si 0.30
10B	"	3.87	5.7%	14.1%	-0.6%	CMC 0.31
11B	"	3.94	6.7%	14.8%	-0.7%	CMC 0.30
12A	"	4.00	2.5%	5.4%	+0.9%	-
12B	"	3.82	9.2%	15.5%	-0.08%	CMC 0.42
12C	"	3.85	9.0%	15.4%	-0.05%	CMC 0.67
12D	"	3.91	10.0%	18.0%	-0.4%	CMC 0.98



M. M. Williams
5/31/77

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A-1

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TABLE 1

<u>Test Series</u>		<u>Binder</u>	<u>Location</u>	<u>Rate/qts./cf</u>
<u>Test No.</u>	<u>Ore</u>			
9A	L#1	Control	-	-
9B	L#1	2.0% Starch 1.0% Pot.Sil. 0.01% War	B.S.	0.30
10B	L#1	0.5% CMC 1.0% Pot.Sil. 0.01% War	B.S.	0.31
11B	L#1	0.5% CMC 0.01% War	B.S.	0.30
12A	L#1 (Screened)	Control	-	-
12B	L#1 (Screened)	0.5% CMC 0.01% War	B.S.	0.42
12C	L#1 (Screened)	0.5% CMC 0.01% War	B.S.	0.67
12D	L#1 (Screened)	0.5% CMC 0.01% War	B.S.	0.98

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TABLE 2

A-2

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Test No.	Bag No.	Original Volume In. cf	Volume after 3 Days	Loss	Loss Related To 4 cf			
9A Control	21	2½	4.12	3	4.05			
	22	4	3.90	4½	3.83			
	23	3	4.05	3½	4.01			
	24	4½	3.83	4 3/4	3.79			
	25	3	4.05	3½	3.98			
	26	4	3.90	4½	3.83			
	Average		3.98		3.91	0.07	1.8%	-
9B 2.0% Starch 1.0% Pot.Sil. 0.01% War @ 0.30 qts./cf	51	4½	3.83	5 3/4	3.64			
	52	4½	3.83	6½	3.57			
	53	4	3.90	5 3/4	3.64			
	54	4½	3.83	6½	3.53			
	55	5	3.76	7	3.46			
	56	4½	3.83	6½	3.53			
	Average		3.83		3.56	0.27	7.0%	0.44 11.0%
10B 0.5% CMC 1.0% Pot.Sil. 0.01% War @ 0.31 qts./cf	51	4	3.90	6½	3.57			
	52	4½	3.83	5½	3.68			
	53	4½	3.83	6½	3.57			
	54	4	3.90	5½	3.68			
	55	4½	3.83	5 3/4	3.64			
	56	4	3.90	5½	3.72			
	Average		3.87		3.64	0.23	5.9%	0.36 9.0%
11B 0.5% CMC 0.01% War @ 0.30 qts./cf	51	4	3.90	5 3/4	3.64			
	52	5	3.76	7½	3.42			
	53	3	4.05	4 3/4	3.79			
	54	4½	3.83	6	3.61			
	55	2½	4.12	4½	3.83			
	56	3½	3.98	5	3.76			
	Average		3.94		3.68	0.26	6.6%	0.32 8.0%
12A Control (Screened)	20	4	3.90	5½	3.72			
	21	4	3.90	4½	3.87			
	22	3	4.05	3½	4.01			
	23	3	4.05	3½	4.01			
	24	2½	4.12	3½	4.01			
	25	3½	3.98	4½	3.87			
	Average		4.00		3.92	0.08	2%	-
12B 0.5% CMC 0.01% War	51	5	3.76	7	3.46			
	52	4	3.90	6	3.61			
	53	4	3.90	7	3.46			

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TABLE

Test No.	Bulk Density pcf	Hea Parti
9B	5.73 6.23	1 1
10B	5.90 5.47	1 1.2
11B	5.52 4.92	1.2 1.3
12A	5.03 5.03	2.0 1.4
12B	5.36 5.47	1.2 1.1
12C	5.95 5.69	1.0 1.6
12D	6.23 6.17	1.2 1.0

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TAB 4

BINDER TESTS - FIBER AN

Test No.	Ore	Type	Binder Location	Drop Rate Qts./CF
9A	I#1	-----	Control	-----
9B	I#1	2.0% Starch 1.0% Pot.Sil. 0.01% War	B.S.	0.30
10B	I#1	0.5% CMC 1.0% Pot.Sil. 0.01% War	B.S.	0.31
11B	I#1	0.5% CMC 0.01% War	B.S.	0.30
12A	I#1S	-----	Control	-----
12B	I#1S	0.5% CMC 0.01% War	B.S.	0.42
12C	I#1S	0.5% CMC 0.01% War	B.S.	0.67
12D	I#1S	0.5% CMC 0.01% War	B.S.	0.98

Note: On 12 series test, material was screen screen. Quantity of unders was very s fine rock, tremolite bundles and dust.

TABJ : 5

A-5

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FIBER EVALUATION - LIBBY #1

Date Prod.	Material Identification	Sampling Conditions		Fiber Analysis (F/ml)		
		Date	Location	Min.	Max.	Avg/TWA2/8
5/11	Test 9A Control	5/12	Drop Test	10.26	28.22	17.245
		5/18	Simulated attic 20 - 4 cf Bags	4.28	5.70	4.99/ 1.248
5/12	Test 9B 2.0% Starch 1.0% Pot.Sil. 0.01% War 0.30 qts./cf	5/12	Drop Test	1.28	9.83	3.848
		5/17	Simulated attic 20 - 4 cf Bags	2.92	3.15	3.035/ 0.759
5/11	Test 10B 0.5% CMC 1.0% Pot.Sil. 0.01% War 0.31 qts./cf	5/12	Drop Test	5.13	8.55	6.271
		5/17	Simulated attic 20 - 4 cf Bags	2.03	2.70	2.365/ 0.591
5/11	Test 11B 0.5% CMC 0.01% War 0.30 qts./cf	5/12	Drop Test No Attic Test	2.14	5.99	3.280/
5/11	Test 12A Control	5/12	Drop Test	5.99	23.94	11.045/
		5/18	Simulated attic 20 - 4 cf Bags	1.43	1.66	1.545/ 0.386
5/11	Test 12B 0.5% CMC 0.01% War 0.42 qts./cf	5/12	Drop Test	1.28	5.99	2.923
		5/18	Simulated attic 20 - 4 cf Bags	1.34	1.87	1.605/ 0.401
5/11	Test 12C 0.5% CMC 0.01% War 0.67 qts./cf	5/12	Drop Test	0.43	1.71	1.284/
		5/18	Simulated attic 20 - 4 cf Bags	0.95	1.19	1.07/ 0.268
5/11	Test 12D	5/12	Drop Test	0.43	2.14	1.143
		5/17	Simulated attic 20 - 4 cf Bags	0.50	1.26	0.88/0.22

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BINDER SPRAY SYSTEM
NOZZLE CAPACITIES

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WIPESPORT
SPRAY TESTS 5/10/77

NOZZLE 1/2 GG 40
CURVE ① - 1000 LBS/HR
② - 1400 LBS/HR

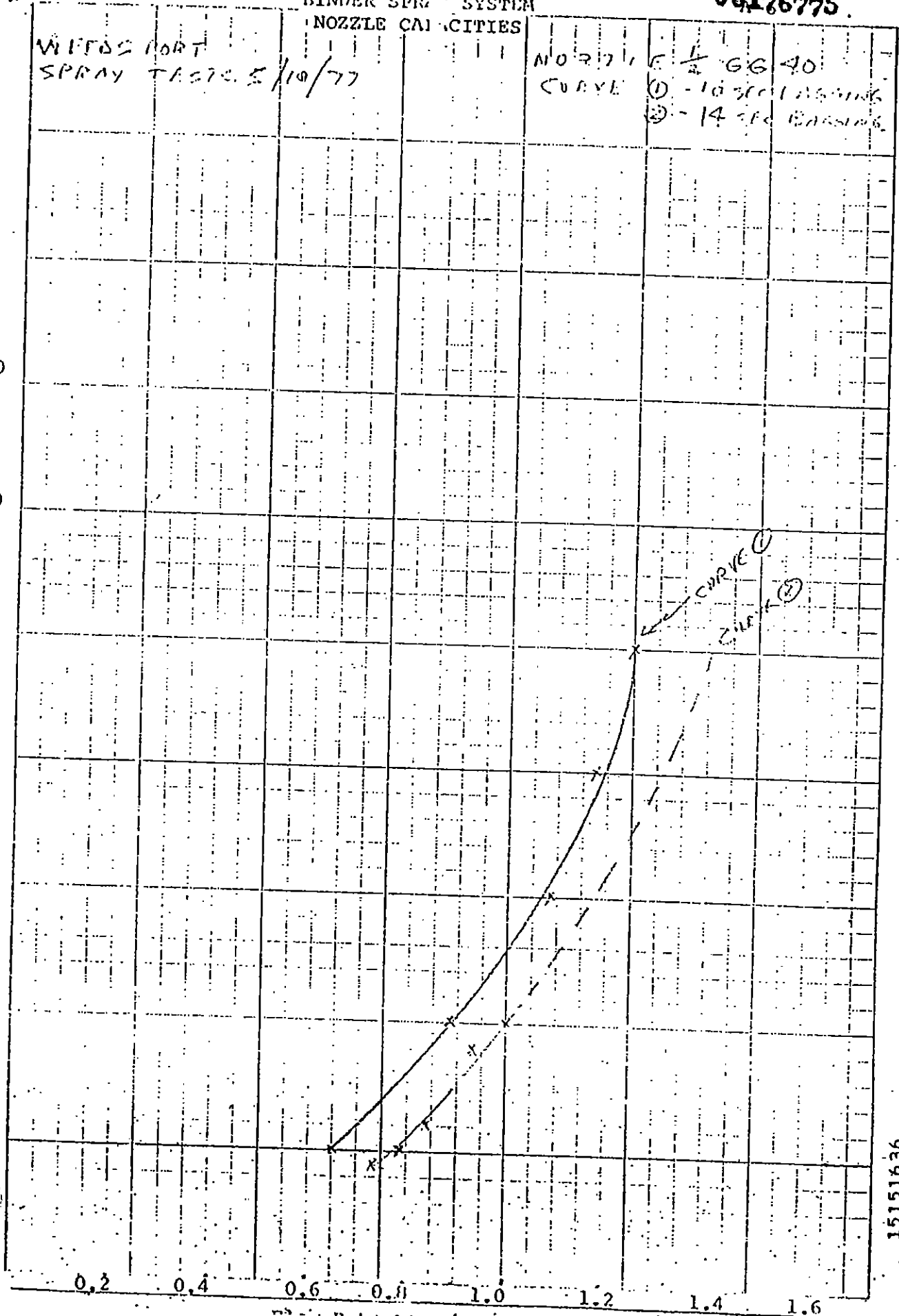
Pressure PSIG

MADE IN U.S.A.
KEUFFEL & ESSER CO.

70
60
50
40
30
20
10

0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6

15151636



NOZZLE CAPACITIES

WEEDSPORT
SPRAY TESTS 5/10/77

MORRIS 1/2 GG32
CURVE ① 10 SEC. BAGGING

Nozzle Pressure PSIG

NOZ 7/8 10 INCH 40 0413
KEUFFEL & ESSER CO.

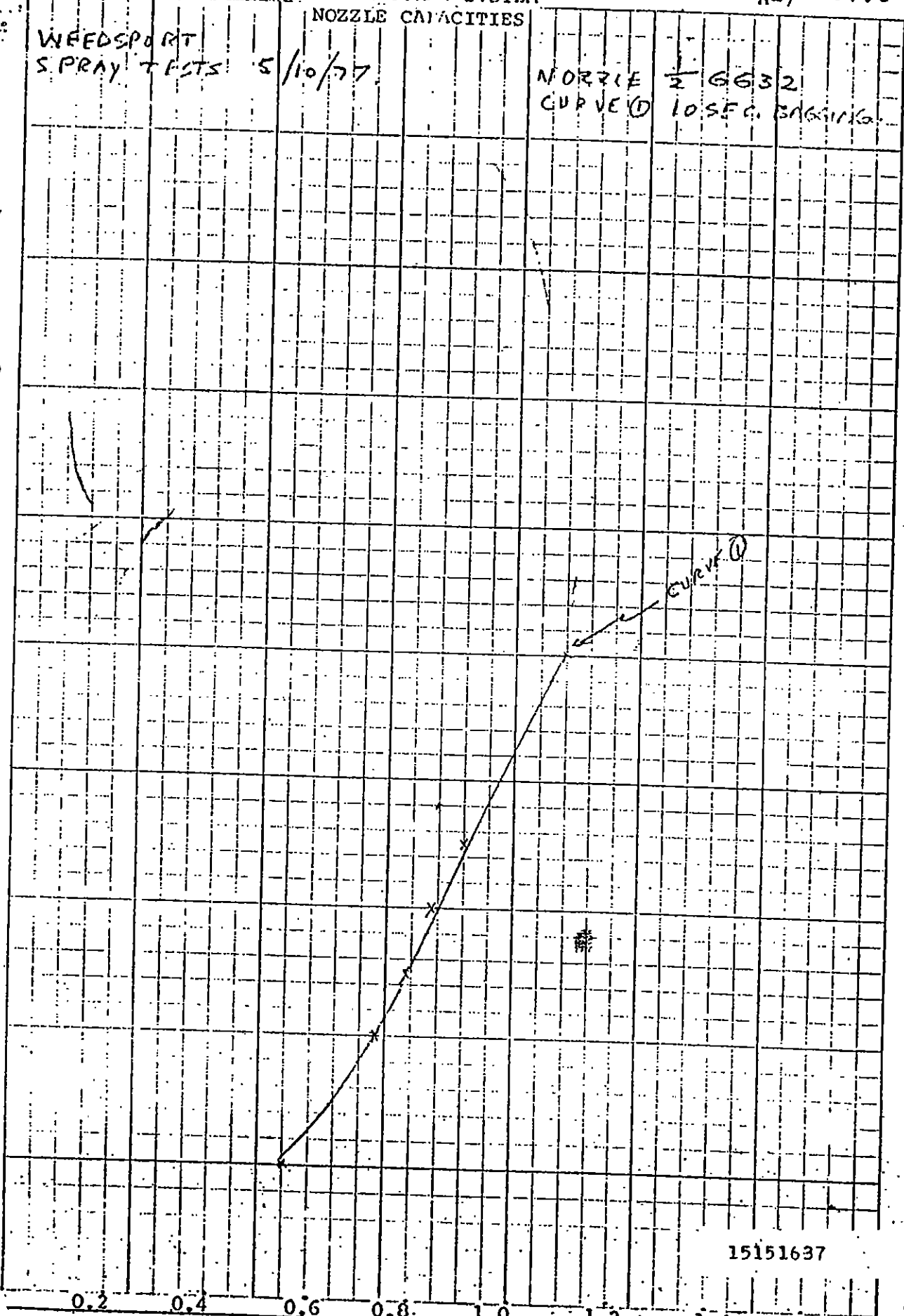
70
60
50
40
30
20
10

CURVE ①

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0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6

Flow Rate Qts./cu. ft.



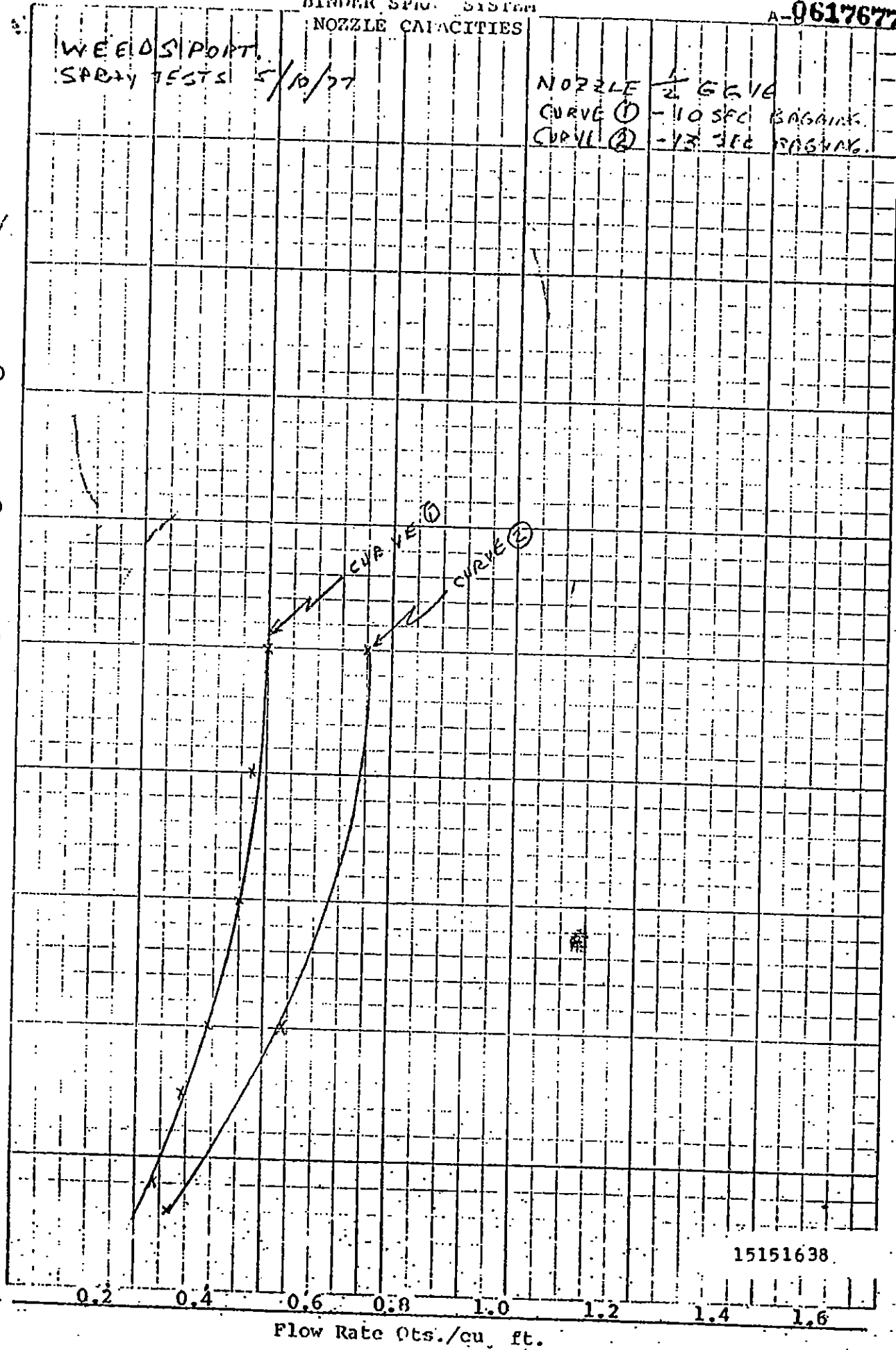
BANDER SPRAY SYSTEM

NOZZLE CAPACITIES

A-06176777

WEEDS/PORT.
SPRAY TESTS 5/10/77NOZZLE $\frac{1}{2}$ G E 1/8
CURVE ① - 110 SFC BAGGING
CURVE ② - 125 SFC BAGGING

le Pressure PSIG

NO. 7 x 10 INCHES
KEUFFEL & ESSER CO.

15151638

Flow Rate Gts./cu. ft.

YOUNG WINNIE DUST TEST
AIR SAMPLING RECORD SHEET

PLANT LOCATION WINDSFORT
CONTAMINANT FLUOR
SAMPLING BY F. W. EATON
DATE: 5/2/77

SAMPLING CONDITIONS:
OUTSIDE
INSIDE DRAFT
VISIBLE DUST

HOUSEKEEPING:

~~CONFIDENTIAL~~

Sample Number	Employee Name	Job Location and Description	Remarks	Pump Number	Pump Off	Pump On	Sampling Time	Flow Rate	Total Sampled Volume	Lab Evaluation
9A-A1			1st	100-6		1700	15	1.6		23.2
9A-B1						1700				24.8
9A-A2			CENTRAL	100-7					17.245	13.2
9A-B2										15.8
9A-A3					1730					11.13
9A-B3					1730					10.26
9B-A1			1st			1345	10	1.6		9.8
9B-B1			2.0% STARCH			1345				8.5
9B-A2			1.0% POTASSIUM SUCRATE							3.42
9B-B2			0.01% WAX						2.840	2.14
9B-A3			0.30 WTS/CF		1415					1.22
9B-B3					1415					3.00

Additional Comments:

Laboratory Evaluation By: Maureen M. Hickey
Date: 5-18-77

YANG WIND & DROT TEST
AIR SAMPLING RECORD SHEET

HOUSEKEEPING:

SAMPLING CONDITIONS:

OUTSIDE

INSIDE DRAFT

VISIBLE DUST

PLANT LOCATION: WEDDSPORT

CONTAMINANT: PM10

SAMPLING BY: F. W. EATON

DATE: 5/12/77

CONFIDENTIAL

Sample Number	Employee Name	Job Location and Description	Remarks	Pump Number	Pump Off	Pump On	Sampling Time	Flow Rate	Total Sampled Volume	Lab Evaluation
0B-01			1st	100-6		1445	10	1.6		8.55
0B-01			0.0-0.5% CMC	100-7		1445				5.13
0B-02			1.0% Potassium Sulfate							5.99
0B-02			0.01% W.M.2							5.13
0B-03			0.31 QTS/CF		1515					5.56
0B-03					1515					5.56
0B-01			1st			1445	10	1.6		5.99
0B-01			0.5% CMC			1445				2.14
0B-02			0.01% W.M.2							2.14
0B-02			0.30 QTS/CF							2.14
0B-02					1630					2.14
0B-03					1630					2.14

Additional Comments:

Laboratory Evaluation By: W. W. Eaton

Date: 5-15-77

GRACE

AIR SAMPLING RECORD SHEET

PLANT LOCATION WEDDERSPORT
 CONTAMINANT FIBER
 SAMPLING BY F.W. EASON
 DATE: 5/12/77

SAMPLING CONDITIONS:
 INSIDE DRAFT
 OUTSIDE
 VISIBLE DUST

CONFIDENTIAL

A-11
 HOUSEKEEPING:

15151641

Sample Number	Employee Name	Job Location and Description	Remarks	Pump Number	Pump Off	Pump On	Sampling Time	Flow Rate	Total Sampled Volume	Lab Evaluation
A-01			CONTROL 1st	100-6		0830	10	1.4		23.5
B-01				100-7		0830				4.1
A-02			DUSTY DURING DRAIN				5		11.045	5.1
B-02			NOTE: SAMPLE 12A-02 5min CHANGED DUE TO DEFECTIVE FILTER							4.1
A-03					0900					3.1
B-03			1st		0930		40	1.4		3.1
A-04			0.5% CNC, 0.01% WARE		0930					5.1
B-04			0.42 QTS / CF							2.1
A-05									2.925	1.1
B-05										1.1
A-06										1.1

Additional Comments: (1) ON JUL 12 SERIES TESTS TERMINATED
SCREENED OVER 14 AREA SCREEN & ALL CYCLONE TUBES RECOVERED
 Laboratory Evaluation By: Diagnosed M. H. H. H.
 Date: 5-17-77